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# PRELIMINARY REPORT

on the

# EFFECTIVENESS OF THE PEELING METHOD OF CONTROL RELATIVE TO THE DESTRUCTION OF DENDROCTONUS BROODS

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PRELIMINARY REPORT

on the

EFFECTIVENESS OF THE PEELING METHOD OF CONTROL

RELATIVE TO THE DESTRUCTION OF DENDROCTONUS BROODS

## INTRODUCTION

The year 1905 marks the institution of the first barkbeetle control project in the United States. This project was in the vicinity of Colorado Springs and Palmer Lake, Colorado, and the method of treatment used was felling the trees and peeling the infested portion. The success of this method was based on the theory that the removal of the immature Dendroctonus broods from their normal environment, and exposure to the weather, would soon result in their destruction. This assumption seemed reasonably sound, and remained unquestioned until a few years ago when it was found that immature Dendroctonus broods when released by peeling infested trees could reach maturity if protected from predators.

In order to determine the per cent of mortality or future of Dendroctonus broods liberated by the peeling method of control, the following project was included in the investigative program of the Coeur d'Alene Forest Insect Field Station for the seasons 1928-29. This project was assigned to the writer and

the initial study with lodgepole pine conducted during the months of June, July, and August, 1928, in a heavy mountain pine beetle infestation on the Bitterroot National Forest.

## SCOPE

The experimental work in connection with this project was divided into two parts: (1) to determine the possibility of Dendroctonus monticolae broods attaining maturity when released from their host by the peeling method of control and allowed to remain on the ground, but protected from all predators; (2) to determine the disposal of Dendroctonus broods when liberated from their host by the peeling method of control and permitted to remain on the forest floor subjected to all prevailing weather conditions and predators inhabiting the area.

For the first part of the experiment a cage was constructed measuring 6 feet long, 2 feet wide, and 1 foot deep. It consisted of a light framework of wood covered with closely-woven wire screen, and was divided into three separate compartments, one for larvae, pupae, and new adults. (Fig. 1). On a site selected in an infested lodgepole pine stand the ground cover and 3 inches of soil were removed from a space large enough to accommodate the cage. The soil and duff were replaced in the bottom of the cage so as to present as nearly a normal situation as possible.

On June 7 a few strips of lodgepole pine bark from an infested tree were dropped on the duff in each compartment, followed by D. monticolae broods numbering 120 larvae in all stages of development, 175 pupae, and 130 new adults, assimilating conditions which would result from the peeling method of control. It was believed that the best results from this experiment would be secured by leaving the duff and brood undisturbed as much as possible until the final examination. Therefore, very brief inspections were made during this period.

RESULTS OF EXAMINATIONS OF CAGED DENDROCTONUS BROOD

Larval Compartment

June 17. No brood being visible, six square inches of duff were moved, disclosing three active pupae. No further examination was made at this time.

June 22. The three pupae that were seen on the 17th were still active when disturbed.

June 24. Additional duff was examined and eight active larvae were exposed to view. The three pupae seen on previous occasions were still active. At this time it was found that ants had gained entrance to this compartment.

August 11. All the duff and soil were removed from the compartment and carefully examined. No D. monticolae brood was found. A few small centipedes were collected from the duff and it is believed that these chilopods and the small ants that had entered the cage had disposed of the brood.

Pupal Compartment

June 17. Several of the bark strips were moved disclosing 11 pupae, four of which were nearing the new adult stage.

June 22. At this time three new adults were found clinging to underside of bark strip.

June 24. The three new adults seen on the 22d were still on underside of bark strip and were beginning to turn dark in color. On this date a number of small ants were observed crawling about on the inside of the pupal section. A small chunk of freshly-cut lodgepole pine was placed in this compartment to determine if new adults formed in this manner would attack.

August 22. The small section of lodgepole pine was removed and the duff carefully examined; no brood was found. An examination of the wood section disclosed four attacks. Short egg galleries had been constructed but no eggs were found. Individual beetles were present at end of each gallery and were active when bark was removed. Centipedes and ants were considered responsible for the loss of the brood in this compartment.

New Adult Compartment

June 17. No new adults were visible. On turning over several bark strips it was found that the beetles were gathering in bunches on the underside. A small section of freshly-cut lodgepole pine was placed in this compartment to determine if new adults released before normal emergence would successfully attack.

June 22. Boring dust was visible at three places on the section of lodgepole pine, and it was apparent that a few of the new adults had attacked and were beginning to construct egg galleries.

August 22. The small section of lodgepole pine was removed and the duff carefully examined. No new adults were found remaining in the cage. The section of wood removed from this compartment measured 17 inches in length and 6 inches in diameter. Twenty-seven egg galleries were disclosed when all the bark was removed. The longest gallery measured 6 inches in length and contained larval mines with small larvae in the lower portion and eggs in the upper part. (Fig. 2). As no ants or centipedes had been seen in this compartment, it is not known what became of the new adults that failed to attack the section of lodgepole pine placed in the cage.

The following table shows the weather variations and rainfall between the dates June 7 and August 22, 1928. Observations were made at the temporary field station a quarter mile from the location of the experiment.

| | Average | | Range of | | Rainfall |
|---|---|---|---|---|---|
| | Maximum | Minimum | Maximum | Minimum | Inches |
| June 7-30 | 67° | 36° | 52°-84° | 22°-49° | 0.83 |
| July 1-16 (no data 17-31) | 77° | 39° | 63°-93° | 32°-48° | 0.79 |
| August 1-31 | 78° | 33° | 60°-96° | 23°-48° | 0.85 |

Considerable rain had fallen during the experiment and with a lack of sufficient ventilation in the cage a very mouldy condition prevailed. Below freezing temperatures were recorded a number of times between June 7 and August 22. It is believed that the mouldy situation aided by the low temperatures created an environment having a tendency to retard the development of the Dendroctonus brood.

The second part of the experiment consisted in the establishment of 34 plots for the making of observations as to the mortality of Dendroctonus broods released by peeling. These plots were placed so as to represent various types of ground cover and duff, all exposures, as well as altitudes ranging from 4,900 to 5,400 feet. (Fig. 4). Thirty-one of the plots were 1 foot square, which is a convenient size for close observation; another plot was 1 foot wide by 10 feet long, while the two remaining plots were inclosed with wire screen cones 1 foot in diameter.

Dendroctonus monticolae larvae, pupae, and new adults were taken from infested trees and immediately dropped on the surface of these plots. The average number of brood for the small plots was 81, while 1,000 were placed on the larger one. The total number of D. monticolae brood liberated on the 34 plots was 3,673, or approximately the number that would have been released by the peeling method of control from two average-sized infested lodgepole pines at date of experiment.

On the first day the plots were established ants were found to be the only factor in the disposal of all the D. monticolae brood on 8 of them, and responsible for the removal of 46 per cent of the brood on 8 others. The shortest time recorded for entire removal of brood from one plot by ants was 5 hours. Within the one large plot on which 1,000 D. monticolae brood were placed, ant activity was observed for 6 hours on June 25 and 4 hours on June 26, at which time the plot was examined and 38 of the brood found remaining in the duff. While ants were considered to be responsible for all the missing brood, other predators may have assisted during the intervals when plot was not under observation. At the end of 6 days, 10 of the brood still remained on this plot. Nine other plots situated in areas where ants were plentiful required from 2 to 7 days before all the brood disappeared.

The greatest ant activity was observed on plots with shallow duff on a south or east exposure, in areas with the greatest amount of unobstructed sunlight. (Fig. 5). Thirty-three of the plots were subjected to considerable rainfall, while the study was in progress, and during heavy showers no ant activity was observed. Eight plots, including the two that were enclosed by wire screen, were placed on a steep north slope. Seven of these were in duff consisting of deep moss matted with lodgepole pine needles, and averaging from 5½ to 8½ inches to mineral soil. (Fig. 6). On this type of ground cover ants were almost entirely absent. They were observed on one plot shortly after it was established. Two pupae were carried away at this time. After the brood had wriggled down into the duff no further ant activity was observed on the surface of this or of the other six plots. A close examination was made of the duff on this exposure, but no ants were found within it. Regardless of the absence of ant activity the Dendroctonus broods were in some manner destroyed. A few centipedes were collected from the lower portion of the duff and it is believed that they were responsible for this destruction. From 12 to 14 days were required for the Dendroctonus broods to disappear from these plots. Later when the plots that had been inclosed by wire cones were examined, it was found that centipedes had gathered in considerable numbers in the duff; 31 were collected from one plot

and 16 from the other. A number of these centipedes were confined in a cage along with Dendroctonus brood and kept under observation. It was found that these insects were readily accepted by the centipedes as food.

## CONCLUSIONS

It was expected that the wire-covered cage used in the first part of the experiment would exclude all predators, but due to the opening of some of the joints, ants and centipedes gained entrance.

### Larval Compartment

The final results show that while 2.5 per cent of the larvae had reached the pupal stage, none of the brood reached maturity, owing to the activity of ants and centipedes that had gained entrance into the cage.

### Pupal Compartment

This compartment was also subject to the entrance of predators, and of the original 175 pupae, only 2.3 per cent survived. These transformed to new adults and attacked the small section of lodgepole pine placed in the cage. At the time of final examination no eggs were found in the galleries which were still under construction.

### New Adult Compartment

It was found that 31.5 per cent of the new adults had attacked the section of lodgepole pine placed in their compartment, constructed egg galleries, and that the longest gallery contained eggs and young larvae.

This experiment tends to show that when D. monticolae broods are released from their host and protected from other disturbing agencies, it is possible for larvae to transform to pupae, pupae to new adults, and new adults to attack and construct egg galleries under caged conditions.

In the second part of the experiment the D. monticolae broods were released from their host and dropped on the duff on marked squares or plots, and subjected to all sorts of weather conditions and agencies of destruction. It was found that ants were the dominating factor in the destruction of the broods on all but the north exposure. In the dense lodgepole pine stands on north slopes (Fig. 7), the duff usually consists of a deep covering of moss varying from 5 to 8½ inches in depth. Ants were found in limited numbers on the north exposure, but only at the higher elevations where the deep moss was replaced by other forms of ground cover. From the evidence secured from seven of the plots, ants avoid this type of ground cover. Centipedes were found in small numbers over the entire moss-covered area, but had apparently concentrated on the plots containing the D. monticolae brood.

The final results tend to show that ants disposed of the greater portion of the Dendroctonus brood placed on the plots located on the south, east, and west exposures, while on the north exposure the brood was destroyed by centipedes. It is believed, however, that the

data secured from this experiment are by far too limited to furnish a dependable solution. On a control project where from one to five thousand trees are treated a food supply would be created which might be more than the predatory life within the area could destroy. Such a condition could possibly result in a certain per cent of the broods liberated by this method of control reaching maturity.

Respectfully submitted

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Figure 1
View of cage with three compartments used to protect Dendroctonus monticolae brood from predators, while reaching maturity. (See description page 2).

Figure 2
View showing Dendroctonus monticolae egg gallery with egg niches and larval mines on section of lodgepole pine removed from the new adult compartment in screened cage. (See description page 4).

Figure 3
Small lodgepole pine chip with bark removed showing two short Dendroctonus monticolae egg galleries. This chip was used as a support for section of lodgepole pine placed in the new adult compartment in screened cage.

Figure 4
View showing a series of ant plots with markers placed 10 yards apart, crossing over top of high ridge. Ants were found to be numerous and active on the plots on this area. Timber stand consists of lodgepole and yellow pine. (See description page 5).

Figure 5
Near view of square-foot ant plot placed in shallow duff on southern exposure. In this type of duff ants were very active in removing the Dendroctonus monticolae brood.
(See description page 7).

Figure 6
Near view of square-foot ant plot placed in deep moss on northern exposure. In this type of duff the Dendroctonus brood placed on plot was destroyed by centipedes. (See description page 7).

Figure 7
View showing steep north-facing slope with lodgepole pine stand. The duff on these slopes usually consists of a covering of moss from 5 to 8½ inches deep, and very few ants are present. (See description page 9).